AFE Model Solutions
Spring 2012

1. **Learning Objectives:**

1. The candidate will understand the types of risks faced by an entity and be able to identify and analyze those risks.

4. The candidate will understand the means available for managing various risks and how an entity makes decisions about appropriate techniques.

Learning Outcomes:

(1c) Identify and analyze operation risks faced by an entity, including but not limited to:

- Market Conduct (e.g., sales practices)
- HR risk, e.g., productivity, talent management, employee conduct
- Process risk, e.g., supply chain R&D
- Technology risk, e.g., reliability, external attack, internal attack
- Judicial risk, e.g., litigation
- Compliance risk, e.g., financial reporting
- Internal and external fraud
- Execution risk
- Governance risk
- Supplier/partner risk
- Disaster risk, e.g., natural disaster, man-made disaster

(4s) Define strategic risk.

(4v) Define operational risk.

(4x) Evaluate examples of company disasters that were the result of these types of risks – what the exposure was, what occurred, the sequence of events, what actions management took, didn't take and could have/should have taken, what the financial impacts and general consequences were.

Sources:

Operational and Reputation of Risks: Essential Components of ERM

LO1 - FE-C159-09: Countering the Biggest Risk of All

FE-C106-07: Mapping of Life Insurance Risks, AAA Report to NAIC

1. Continued

Commentary on Question:
Operational risk events can be classified into four different categories. This question requires a clear understanding of the types of operational risk (retrieval) in order to identify (comprehension and analysis) the scenarios presented.

Basic definitions and identification of operational risks were both well completed. Candidates could have done a better job providing full definitions (i.e. key elements of the definitions were often omitted) and more robust justifications (i.e. justifications provided were superficial).

Solution:

(a) Describe each of the categories A through D.

Commentary on Question:
Part (a) was looking for a basic understanding of each of the operational risks. Most candidates displayed a reasonable grasp of these risks.

A near miss is an adverse event that has been identified without producing a direct loss reflecting possible operational inefficiencies to be recorded, investigated and improved upon as deemed necessary.

Expected incidents are the costs of doing business.

An unexpected incident has a low probability with large financial impact representing the largest component of economic capital.

Catastrophic incidents can kill the company and are impossible to hedge.

(b) For each of the five scenarios:

(i) Indicate whether it is an operational risk incident or not. Justify your response.

(ii) If it is an operational risk incident, categorize it into one of the four categories A through D. Justify your response

Commentary on Question:
Most candidates were readily able to identify the risks as operational or not. Categorization of the scenarios was completed well; however, justification for the categorization frequently missed the mark.

1. Continued

I. Mark Peacock and several internal auditors resign. As a result, internal controls for Zoolander are weakened. After Zoolander files its Annual Statement, a material error is discovered which results in re-filing costs and regulatory fines amounting to $2.1 million

The resignation is an operational risk resulting in people and process failure. The high severity and low probability make this an unexpected incident.

II. Kelly downgrades Zoolander after identifying gaps in Zoolander's internal controls. This creates a "run on the bank" due to the downgrade put option on the GIC business.

"Gaps in internal controls" is a process failure type of operational risk. The event is catastrophic due to its potential magnitude which could bankrupt Zoolander.

Note: Many candidates identified this as non-operational due to Kelly's involvement; however, the underlying root cause is internal controls.

III. Zoolander's Term Life sales are greatly reduced due to Periwinkle undercutting Zoolander on pricing.

Competitive risk is classed as operational of the expected type since it is an essential element of doing business. An organization can readily manage its desired competitive position.

Note: Most students earned partial credit by identifying this as non-operational strategic competitive risk.

IV. A flu pandemic causes millions of insurance benefit payout for Zoolander Life, creating a significant surplus strain on the company.

The scenario is a non-operational insurance mortality/morbidity risk.

V. Zoolander's manual disability claims process results in numerous errors which are subsequently caught and fixed before payments are finalized.

The failure in claims process is an operational risk. The near miss reveals inefficiencies in process without causing a direct loss.

Note: Partial credit was earned by classifying as an expected incident due to the frequency of occurrence.

2. Learning Objectives:

1. The candidate will understand the types of risks faced by an entity and be able to identify and analyze those risks.

2. The candidate will understand measures of corporate value and be able to analyze the data in corporate financial statements.

3. The candidate will understand how the financial risks faced by an entity can be quantified and the use of metrics to measure risk.

4. The candidate will understand the means available for managing various risks and how an entity makes decisions about appropriate techniques.

Learning Outcomes:

(1a) Identify and analyze financial market risks faced by an entity, including but not limited to: currency risk, credit risk, spread risk, liquidity risk, interest rate risk, and equity risk.

(1b) Identify and analyze insurance risks faced by an entity, including but not limited to: mortality risk, morbidity risk, catastrophe risk, product risk, and embedded options.

(1c) Identify and analyze operation risks faced by an entity, including but not limited to:

- Market Conduct (e.g., sales practices)
- HR risk, e.g., productivity, talent management, employee conduct
- Process risk, e.g., supply chain R&D
- Technology risk, e.g., reliability, external attack, internal attack
- Judicial risk, e.g., litigation
- Compliance risk, e.g., financial reporting
- Internal and external fraud
- Execution risk
- Governance risk
- Supplier/partner risk
- Disaster risk, e.g., natural disaster, man-made disaster

(1d) Identify and analyze strategic risks faced by an entity including, but not limited to:

- Product sustainability risk
- Distribution sustainability risk
- Consumer preferences and demographics
- Geopolitical risk
- Competitor risk
- External relations risk
- Legislative/Regulatory risk

2. Continued

- Reputation risk
- Sovereign risk

(2d) Demonstrate how to calculate required capital on an economic capital basis:
- Define the basic elements and explain the uses of economic capital.
- Explain the challenges and limits of economic capital calculations and explain how economic capital may differ from external requirements of rating agencies and regulators.
- Demonstrate the ability to develop an economic capital model for a representative financial firm.

(3a) Demonstrate the use of risk metrics to quantify major types of risk exposure in the context of integrated risk management process.
- Demonstrate how each of the financial risks faced by an entity can be amenable to quantitative analysis including an explanation of the advantages and disadvantages of various techniques such as Value at Risk (VaR), stochastic analysis, scenario analysis, and stress testing.
- Describe and evaluate risk aggregation techniques, incorporating the use of correlation, integrated risk distributions and copulas.
- Describe how and why risks are correlated and give examples of risks that are positively correlated and risks that are negatively correlated.
- Assess the overall corporate risk exposure arising from financial and non-financial risks.

(3b) Evaluate the properties of risk measures and explain their limitations.

(3c) Define and evaluate model and parameter risk.

(4e) Describe and evaluate risk management techniques that can be used to deal with financial and non-financial risks.

(4f) Develop an appropriate choice of hedging strategy for a given situation (e.g., reinsurance, derivatives, financial contracting), which balances benefits with inherent costs, including exposure to credit risk, basis risk, moral hazard and other risks.

Sources:
Economic Capital Modeling – Practice Considerations – Milliman

Measurement and Modeling of Dependencies in Economic Capital

Hardy, Investment Guarantees, Ch. 9, Risk Measures

2. Continued

Kalberer, Variable Annuities, Chapters 5, 10, and 11

FE-C106-07: Mapping of Life Insurance Risks, AAA Report to NAIC

Commentary on Question:
Commentary listed beneath question component.

Solution:

(a) Risk can be decomposed into the following three key components: volatility, uncertainty, and extreme events.

Commentary on Question:
Part (a) tested candidates' comprehension-level cognitive skills.

(i) Describe each of these three components.

Commentary on Question:
The candidates generally did relatively well on this subsection. Most candidates were able to define and describe volatility, uncertainty and extreme events.

- Volatility is the risk of random fluctuations in either the frequency or severity of a contingent event.
- Uncertainty involves the risk of misspecifying the model used to estimate claims. It can originate from misestimating parameters within the models.
- Extreme Events include the risk of large common-cause events such as calamities: high impact, low frequency risks.

(ii) For each of these three risk components, state whether the VaR risk measure captures it. Justify your response.

Commentary on Question:
Most candidates knew that the VaR captures volatility but many struggled with the fact that the VaR doesn't capture uncertainty or extreme events.

- Yes, VAR captures volatility
- No, VAR does not capture uncertainty
- No, VAR does not capture extreme events

(iii) For each of these three risk components, state whether the CTE risk measure captures it. Justify your response.

2. Continued

Commentary on Question:
Most candidates knew that the CTE captures volatility and extreme events but many struggled with the fact that the CTE doesn't capture uncertainty. Most candidates also answered correctly that the CTE takes into account the entire tail of the distribution.

- Yes, CTE captures volatility
- No, CTE does not capture uncertainty
- Yes, CTE captures extreme events, CTE takes into consideration the entire tail of the distribution

(b) Define each of the following:
(i) Available Economic Capital
(ii) Required Economic Capital
(iii) Excess Capital

Commentary on Question:
Almost all candidates did very well on this definition type subsection that tested retrieval-level cognitive skills. A common mistake was for candidates to use the definition of the statutory required capital rather than the economic capital.

- Available (economic) capital is the amount of capital the company actually has.
  - Available capital is defined as the excess of the value of the company's assets over the value of its liabilities
- Required EC is the amount the company believes it needs.
  - Required EC is also defined as the capital required to support a business with a certain probability of default.
- Excess capital is the difference between available economic capital and required economic capital.

(c) Describe each of the following approaches to determining aggregate capital levels.

Approach 1: The simple summation method, using VaR 99

Approach 2: The fixed diversification percentage method, using CTE 99 and a fixed diversification deduction of 10%

Approach 3: The correlation matrix method, using VaR 99

2. Continued

Commentary on Question:
Most candidates described all approaches correctly for this subpart that tested retrieval-level cognitive skills. Some gave more details than others (and scored higher as a result) but in general the majority of the candidates answered this part very well.

- Simple Summation involves adding together the stand alone marginal risk capital amounts.
  - Simple Summation ignores diversification benefits
  - Simple Summation produces upper bound for EC number.
- Fixed diversification assumes a fixed percentage deduction from the overall capital figure.
  - The overall capital is based on the simple summation method.
- The Correlation Matrix approach first calculates capital on a stand-alone basis for each risk and then aggregates it using a correlation matrix.

(d) For each approach in part (c), calculate Zoolander's Excess Capital, assuming the market value of assets allocated to the VA LOB is $4,300 million. Do not reflect the hedging program in your calculation.

Commentary on Question:
This subsection was the biggest differentiator for the entire question. It tested the candidates' comprehension-level cognitive skills. The candidates who answered this subsection received most of the grading marks. However, there were a few candidates who received partial grading marks for this section. Oddly, many candidates who responded correctly in part (c) weren't able to perform the calculations in part (d).

- Given values: Expected Losses: VA = 3,000; Market Value of Assets = 4,300
- Available Capital = Market Value of Assets – (Market (Fair) Value of Liabilities + Allowance for Cost of Capital)
- Available Capital = 4,300 – 3,000 = 1,300
- Available Capital = Required Capital (Approach Specific capital) – Excess Capital

- Approach 1: Excess capital = Available capital – sum(VAR 99 – economic reserve) for each risk
- Approach 1 VAR 99 values: Market = (3,800 – 3,000) = 800, Insurance = (3,300 – 3,000) = 300, Operational = (3,100 – 3,000) = 100
- Approach 1: Excess capital = 1,300 – 800 – 300 – 100
- Approach 1 Excess capital = 100

2. Continued

- Approach 2: Excess capital = Available capital – [fixed diversification percentage * sum(CTE 99 – economic reserve) for each risk]
- Fixed diversification percentage = 1 – fixed diversification deduction = 1 – 0.1 = 0.9
- Approach 2 (CTE value – Expected Loss): Market = (3,900 – 3,000) = 900, Insurance = (3,350 – 3,000) = 350, Operational = (3,125 – 3,000) = 125
- Approach 2 Required Capital: = (900 + 350 + 125) * .9 = 1,237.5
- Approach 2 Excess capital = 1,300 – 1,237.5
- Approach 2 Excess capital = 62.5

- Approach 3: Excess capital = Available capital – Required Capital
- Approach 3 Required Capital = (∑∑correlationij * capitali * capitalj)^0.5 where i, j = Market, Insurance and Operational risks
- Capital = VAR 99 – Economic Reserve (from table 1); correlation is from table 2. The capital was for each i, j was calculated in Approach 1
- Approach 3 Required Capital: Market = 1 * 800 * 800 = 640,000
- Approach 3 Required Capital: Insurance = 1 * 300 * 300 = 90,000
- Approach 3 Required Capital: Operational = 1 * 100 * 100 = 10,000
- Approach 3 Required Capital: Market * Insurance = .8 * 800 * 300 = 192,000 Since i * j = j * i, we will just multiply this value by 2 in the total required capital formula
- Approach 3 Required Capital: Market * Operational = .1 * 800 * 100 = 8,000
- Approach 3 Required Capital: Insurance * Operational = .1 * 300 * 100 = 3,000
- Approach 3 Total Required Capital = sqrt (640,000 + 90,000 + 10,000 + 2 * 192,000 + 2 * 8,000 + 2 * 3,000)
- Approach 3 Total Required Capital = sqrt (1,146,000) = 1,070.5
- Approach 3 Excess capital = 1,300 – 1,070.5
- Approach 3 Excess capital = 229.5

(e) Assuming Approach 3 in part (c) is used to determine the aggregate capital level, qualitatively describe how each of the following may change for the VA LOB if Zoolander's hedging program is reflected in the analysis. Justify your response.

(i) Market Value of Liabilities

(ii) Required Economic Capital

Commentary on Question:
This subpart tested candidates' analysis-level cognitive skills. Most candidates correctly answered that the required economic capital should decrease. The Market Value of Liabilities was more challenging because the solution implies that it could either increase or decrease.

2. Continued

- Bottom line answer is that Market Value of Liabilities might decrease but could also increase due to hedging costs exceeding hedging benefits

- Bottom line answer is that Economic Capital should decrease due to increasing Economic Reserves and probable net decrease due to Market & Insurance risk

(f) Zoolander is considering whether to organically expand the VA product line. In addition to capital, state four risk management considerations mentioned in the case study that could impact Zoolander's decision. Justify your response.

Commentary on Question:
Most candidates were able to identify four risk management considerations mentioned in the case study for this subpart that tested the knowledge utilization-level cognitive skills. The grading outline provided several more acceptable answers.

Item 1: How will liquidity, ALM, and immunization strategies be affected? (Liquidity Risk)
Item 2: Is the appropriate hedging strategy in place? (Market Risk)
Item 3: Is sufficient reinsurance in place or available?
Item 4: Is more analysis needed on policyholder behavior? / Is guarantee properly priced?

Additional Answers:
Item 5: Does the company have resources to upgrade pricing and modeling capabilities?
Item 6: Does the company have the resources to upgrade the administration system and maintain compliant?
Item 7: How will the established risk limits be affected?
Item 8: What happens if the company does not grow organically?
Item 9: Can John Badger handle all the hedging responsibilities if the block grows?

3. Learning Objectives:

5. The candidate will understand the components of an ERM framework and be able to evaluate the appropriateness of a framework in a given situation.

6. The candidate will understand the structure of an ERM process in an entity and be able to demonstrate best practices in enterprise risk management.

Learning Outcomes:

(5b) Describe the fundamental concepts of financial and non-financial risk management and evaluate a particular given risk-management framework.

(5d) Explain the elements of risk governance, and demonstrate how governance issues are resolved through organizational structure.

(5f) Explain the perspectives of regulators, rating agencies, stock analysts, and company stakeholders and how they evaluate the risks and the risk management of an organization.

(6h) Describe and assess the elements of a successful risk management function and recommend a structure for an organization's risk management function.

Sources:

Methodology: Assessing Management's Commitment to and Execution of Enterprise Risk Management Processes – S&P publication

Commentary on Question:

This question tested the candidates' understanding of S&P's methodology for assessing a company's commitment to, and execution of, an ERM framework. Candidates not only needed to understand the concepts enough to describe them, but they also needed to be able to apply S&P's methodology to evaluate Zoolander in the case study. Candidates who did well on this question showed that they were able to assess Zoolander's ERM framework based on specific examples in the case study.

Solution:

(a) Describe why S&P believes I, II, and III are important.

Commentary on Question:

Part (a) was generally well-answered and was intended to point the candidates to the applicable section of the syllabus that was required for answering the rest of the question. This part tested candidates' retrieval-level cognitive skills.

<u>Importance of ERM Culture</u>

A positive, supportive risk-management culture that embeds ERM into all operations of the company is a good indication that the company takes risk management seriously.

3. Continued

Alternative solutions:
Other solutions that indicated the importance of an ERM culture because it helps embed/integrate ERM within the company's operations were also accepted.

Importance of Risk Controls
A company's ability to identify sources of risk effectively will enable it to develop tools to measure and manage those risks, thus making it a more successful company

Importance of Emerging Risk Management
An effective "early warning system" ensures that risks that could potentially adversely impact the company's operations are flagged in time for mitigating actions to be implemented.

(b) Identify ten criteria, which have direct or indirect supporting references within the Case Study, that Zoolander should be prepared to discuss with S&P.

Commentary on Question:
For part (b), the question asked to identify criteria which had direct or indirect references to the case study. This part of the question was intended to set up the framework for answering part (c). Candidates that answered well listed criteria that were applicable to the case study (as opposed to general criteria). This part tested candidates' comprehension-level cognitive skills.

1. ERM is embedded into all operations of the company
2. There is an independent ERM department that reports to senior management separate from profit centers
3. Senior management takes the lead in ERM
4. Senior management makes decisions that are consistent with the company's risk appetite
5. Incentive compensation rewards managers based on the analysis of risk-reward trade-offs and value creation
6. Written policies that establish hard and soft limits
7. Reinsurance counterparty guidelines and performance relative to guidelines
8. All material risk categories are included
9. Reports indicating company's attempt to identify emerging threats to its operations
10. Evidence that mitigating processes are implemented in anticipation of potential contingencies and not as a result of occurrence

3. Continued

Other acceptable answers:

- Evidence that the company's risk profile is understood at a high level
- Management understands how risk limits were established
- Examples of how group risk appetite translates into individual risk limits
- Reports showing compliance history and remediation process
- Coordination and consistency in the measurement of the same risk across units

(c) Evaluate Zoolander with respect to the criteria chosen in part (b). Provide specific examples to support your evaluations.

Commentary on Question:
Part (c) consisted of the most points in this question and tested candidates' analysis-level cognitive skills. It separated the well-answered papers from those that were not answered very well. Note that this question asked for "specific" examples from the case study to support the candidates' evaluations of the criteria identified in part (b). Hence it was very important to refer to the case study with specific examples when answering this question. General examples did not earn credit. Note that the answers below correspond to the numbered criteria in the model solution for part (b), above. Other answers that gave specific case study examples and pertained to acceptable criteria for part (b) earned credit for part (c).

1. ZLIC meets the criteria.

   Intro memo for Bill Buck has duties outlined to start embedding ERM.

   ERM officer will work closely with department heads, have staff meeting access/exposure, present internal ERM seminar, set up ERM council with participation from departments.

2. ZLIC partially meets criteria.

   Positive: ERM officer isn't in profit center.

   Negative: ERM officer is new and should report to CFO, CEO, or board. Instead, he reports to EVP, Planning.

3. ZLIC does not meet criteria.

   Risk committee has been disbanded.

   ERM officer reports to EVP, Planning, instead of CEO.

   ERM officer has no board access.

3. Continued

4. ZLIC does not meet criteria.

   Risk appetite meeting minutes show process of setting risk appetite is only at an initial stage.

   Risk appetite meeting had few business unit participants.

5. ZLIC does not meet criteria.

   ZLIC incentive comp plan does not include risk-reward trade-offs, but instead uses simple actual-to-projected formulas.

6. ZLIC partially meets criteria (controls are weak).

   Risk Appetite Meeting refers to Risk Appetite Statement, but this is only a draft and establishing limits is not part of the ERM officer's duties.

   CIO sets informal limit on derivative positions.

7. ZLIC partially meets criteria.

   Ratings drop for Rose mentioned in product committee report, but no guideline is set.

   Chief actuary is only "cognizant of the concentration of counterparty risk with reinsurers."

8. ZLIC does not meet criteria.

   ALM control is only to transfer assets if value of assets diverges from liabilities and match durations - no attempt to identify and control investment-related risks.

   Liquidity risk model lacked completeness by not testing "market-wide liquidity crunch."

9. ZLIC meets criteria.

   ZLIC can show it has hired Cobalt Consulting to identify risks to share at senior management strategic review.

   Economic capital project may help identify risks that could emerge as threats.

3. Continued

10. ZLIC partially meets criteria.

    ZLIC is exploring alternative reinsurers to replace Rose.

    Economic capital project is only reactive.

4. Learning Objectives:

6. The candidate will understand the structure of an ERM process in an entity and be able to demonstrate best practices in enterprise risk management.

Learning Outcomes:

(6c) Articulate risk objectives; demonstrate how to define and measure an organization's risk appetite; and demonstrate how an organization uses risk appetite to make strategic decisions.

(6f) Demonstrate how risk metrics can be incorporated in the risk monitoring function as part of an ERM framework.

(6g) Explain means for managing risks and demonstrate measures for evaluating their effectiveness.

Sources:

Risk Appetite Statements: What's on your Menu, Risk Management

Segal, Corporate Value of Enterprise Risk Management, Ch. 6

Kalberer, Variable Annuities, Ch. 11

Commentary on Question:

This question tests the candidate's ability to not only understand what a Risk Appetite Statement (RAS) is, but also what guides the formation of a RAS. Candidates are required to understand the shortcomings of Zoolander's RAS, and perform analysis on the risk exposure of the Term block as per the case study.

For part (a), candidates should identify key principles that form the basis of a RAS, not the methodology. This part tested their lower level retrieval cognitive skills. Many candidates performed poorly in this section.

For part (b), candidates were asked to assess Zoolander's preliminary RAS in light of these principles. This question tested their higher order knowledge utilization cognitive skills. Those candidates that struggled to identify these principles also struggled to critique Zoolander's RAS.

For part (c), candidates were asked to assess the risk exposures and risk limit of the term block. This part tested both the higher order cognitive skills of comprehension and knowledge utilization. While many candidates performed very well for (i) and (ii), fewer candidates got (iii) correct. Most candidates were able to conclude that the risk exposure for term exceeds the risk limit for part (iv).

4. Continued

Solution:
(a)

(i) Define "Risk Appetite Statement."

Risk appetite statement is an expression of judgment by management/ERM committee as to the level of maximum enterprise risk exposure shareholders are comfortable with.

Risk appetite is defined in terms of the limits the enterprise will manage to related to value at risk, capital at risk and income at risk

(ii) Identify and describe the six key principles that should be considered when forming a Risk Appetite Statement.

1. Strategic alignment
   Risk appetite statement should highlight the link between risk and strategic goals.

2. Shareholders' interests
   Risk appetite statement needs to appropriately balance the various needs, expectations, risk/reward preference, investment horizons, etc. of a wide range of internal and external stakeholders.

3. Alignment with corporate values and culture
   Risk appetite statement should articulate the corporate values and attitudes to risk, and to set a clear "tone from the top" with regard to risks to reputation and brand value.

4. Risk management capacity and capability
   Risk appetite statement should be explicitly calibrated to the financial risk taking capacity as well as the organization's specific risk management capabilities.

5. Total portfolio perspective
   Risk appetite statement should explicitly provide for the recognition and management of diversification and concentration effects across the enterprise risk portfolio.

6. Returns commensurate with risks
   Risk appetite statement should facilitate the setting of target return expectations relative to risk appetites.

4. Continued

(b) Critique the preliminary Risk Appetite Statement discussed during the consensus meeting on April 11, 2011, based on the six key principles in part (a)(ii).

1. The RAS is not aligned with Zoo's strategic goals; strategic goals should be more clearly articulated.
2. Zoolander's risk appetite statement lacks a measure of return for shareholders' equity or financial ratings. It does not incorporate the needs of shareholders or rating agencies.
3. The RAS is not aligned with Zoo's corporate values; corporate values should be more clearly articulated. RAS should be linked with incentives and comp program
4. RAS should REALISTICALLY consider current or reasonably obtainable risk management capabilities (e.g. YRT with Rose reinsurance, dynamic hedging capabilities, management strengths).
5. There is very limited consideration given for the diversification benefit of various lines of business.
6. Required capital growth not an issue if ROC is commensurate with risk.

(c) Regarding the Term Life block:

(i) Determine the initial risk exposure for Term Life.

Initial ERE (LOB) = [sqrt(RC) − 0.75]^2
Initial ERE (Term Life) = [sqrt(15) − 0.75]^2 = 9.75

(ii) Calculate the enterprise risk exposure for Term Life.

Remainder = ERE (Zoolander) − Initial ERE (all business segments)
ERE (Zoolander) = 167.9 million
Initial ERE (GIC) = [sqrt(45.2) − 0.75]^2 = 35.68
Initial ERE (Disability Insurance) = [sqrt(10) − 0.75]^2 = 5.82
Initial ERE (VA) = [sqrt(97.7) − 0.75]^2 = 83.44
Initial ERE (all business segments) = 35.68 + 5.82 + 9.75 + 83.44 = 134.69
Remainder = 167.9 − 134.69 = 33.21 million
Remainder (Term Life) = Remainder x Initial ERE (Term Life) / Initial ERE (all business segments)
Remainder (Term Life) = 33.21 * 9.75 / 134.69 = 2.40 million
ERE (Term Life) = Initial ERE (Term Life) + Remainder (Term Life)
ERE (Term Life) = 9.75 + 2.40 = 12.15 million

4. Continued

(iii) Calculate the risk limit for Term Life.

Risk Limit (Term Life) = Optimal ERE% (Term Life) x Risk Appetite (Zoolander)
Risk Appetite (Zoolander) = 200 million
General account asset in Term Life = 468.6 million
Total general account asset in 4 BU = 6,717 + 654.4 + 468.6 + 3,834.1 – 3,348.5= 8,325.6 million
Optimal ERE% (Term Life) = 468.6 / 8,325.6 = 5.6%
Risk Limit (Term Life) = 200 x 5.6% = 11.3 million

(iv) Recommend an appropriate action for Bill Buck given the results of the calculations above. Justify your recommendation.

Based on calculation above:
ERE (Term Life) > Risk Limit (Term Life)

In theory, Bill should take action to reduce the risk exposure of the term block to be within limits and notify the risk committee of this breach (if they are not already aware)

5. **Learning Objectives:**

4. The candidate will understand the means available for managing various risks and how an entity makes decisions about appropriate techniques.

6. The candidate will understand the structure of an ERM process in an entity and be able to demonstrate best practices in enterprise risk management.

Learning Outcomes:

(4b) Demonstrate means for transferring risk to a third party and analyze the costs and benefits of doing so.

(4f) Develop an appropriate choice of hedging strategy for a given situation (e.g., reinsurance, derivatives, financial contracting), which balances benefits with inherent costs, including exposure to credit risk, basis risk, moral hazard and other risks.

(6a) Demonstrate the ERM process steps to be followed once the ERM framework is in place:

- Risk identification
  - (i) Defining and categorizing risk
  - (ii) Qualitative risk assessments
- Risk quantification
  - (i) Scenario development/types of scenarios
  - (ii) Individual risk quantification, including inherent vs. residual exposures
  - (iii) Quantifying enterprise risk exposure, including correlations of risks
- Risk management
  - (i) Defining risk appetite
  - (ii) Managing enterprise risk exposure towards risk appetite
- Internal reporting
  - (i) Performance measurement
  - (ii) Performance management and incentive compensation
- External disclosures
  - (i) Shareholders
  - (ii) Rating agencies
  - (iii) Regulators

(6e) Demonstrate how ERM is able to contribute to shareholder value creation and how the performance of a given firm or venture may be evaluated against its objectives including total returns.

Sources:

Segal, Corporate Value of Enterprise Risk Management, Ch. 8

FE-C117-07: Doherty, Integrated Risk Management, Ch. 8, risk Management Strategy: Duality and Globality

5. Continued

Commentary on Question:
Overall candidates performed well on the numerical part of the question. Most candidates did not apply the information in parts (i) of sections (c) and (d) specifically to Borah. In most cases, candidates provided the definitions rather than explicit examples of Borah's situation.

Cognitive levels tested:
(a) comprehension
(b) analysis
(c) (i) retrieval (ii) knowledge utilization
(d) (i) retrieval (ii) knowledge utilization

Solution:
(a) Calculate the expected value of each division's market value based on its Vice President's prediction.

West Coast VP: Division's expected value = 30*0.3 + 400*0.7 = 289
EastCoast VP: Division's expected value = 30*0.3 + 400*0.7 = 289
Mid West VP: Division's expected value = 280M

(b) Determine whether each Vice President will hedge the price of oil. Justify your responses.

Commentary on Question:
Candidates who had adjusted the market values by the cost of the hedge were also given full credit. Both solutions are shown below.

(i) East Coast VP:
Expected division's value with hedge = 285

Alternate Answer:
Market value with hedge = 275 (after transaction costs)

Expected division's value without hedge > expected division's value with hedge
The East coast VP will not hedge.

(ii) West Coast VP:
No Hedge:
Market value when "Catastrophe" = 30
Market value when "Paradise" = 400
Utility when "Catastrophe" = 30^0.5 = 5.48
Utility when "Paradise"= 400^0.5 = 20
Expected utility = 5.48*0.3+20*0.7=15.64

5. Continued

With Hedge:
Market value = 285
Utility = 285^0.5=16.88

Alternate answer:
Market value with hedge = 275 (after transaction costs)
Utility = 275^0.5 = 16.58

Utility (no hedge) < utility (with hedge)
West Coast VP will hedge

(iii) Mid West VP:
Expected division's value without hedge = $280M
Expected division's value with hedge = 285M
Hedge cost = 10M
NPV (hedge cost) = 285 - 280 - 10 = -5M <0
The Mid West VP will decide not to hedge

(c)

(i) Describe three of the roles and responsibilities of a corporate ERM function.

Commentary on Question:
Full credit was given if candidates listed **any three** of the following items for this part and corresponding part (c)(ii). The majority of the marks were allocated to the main points with partial marks for the sub-points.

1. Build, maintain, and enhance infrastructure:
   - Corporate ERM is responsible to lead the development of new ERM capabilities, to maintain existing ERM infrastructure, and to introduce enhancements over time.
   - Fundamental ERM program infrastructure elements that Corporate ERM builds, maintains or enhances include setting up ERM framework, process steps and risk governance structure, risk identification, risk quantification, risk decision making and risk messaging.

2. Build Buy-in
   - As the champion of the ERM program, the CRO has primary responsibility to build sufficient buy-in for its adoption.
   - Set up: Corporate ERM can maintain low-key, with minimal intrusion from key internal stakeholders.

5. Continued

- Risk identification: Corporate ERM can limit data request, conduct one-on-one interviews with survey participants that are more personal, collaborative, respectful, concise and confidential, hold consensus meeting to give survey participants a sense of ownership in risk identification, and add value to internal audit through delivery of a qualitative risk assessment.
- Risk quantification: Corporate ERM can build baseline valuation model mostly themselves with key input from the person responsible for the strategic plan financial projection. When developing key scenarios, Corporate ERM should respect expertise in business segments, address "black box concerns," and offer help in modeling proposed initiative. In quantifying individual risk exposures, Corporate ERM should use transparent scenarios, provide stable and value-based results, and provide attribution by risk driver.
- Risk decision making: Corporate ERM can do this by providing information on both risk and returns, in the same venue, expressed in terms of changes in the baseline company and the likelihood of achieving it.
- Risk messaging: Corporate ERM program enhances the quality of discussions with stock analysts, which demonstrate management's superior ability to manage risk and returns. In addition, rating agencies tend to react quite favorably to the adoption of value-based ERM program.

3. Ensure Consistency
   - Corporate ERM team must ensure consistency of the ERM program throughout the enterprise.
   - The following aspects require a high level of consistency: definitions, concepts and terminology, tools and techniques, assumptions, metrics, decision making and risk messaging.
4. Act as a Central Clearing House
   - Corporate ERM serves as a central clearing house for ERM information and actions.
   - Corporate ERM can determine the net integrated impact of cross-department risks in Borah acting to offset or exacerbate each other.
   - Corporate ERM coordinates and sorts out disputes involving competing cross-department requests for increase in risk budgeting.
   - Corporate ERM also coordinates risk-priority mitigation decisions enterprise-wide.

5. Continued

- Corporate ERM helps to coordinate responses to risk events as well as inquiries by external stakeholders, facilitating communications and actions among the board, senior management, executive risk owners, subject matter experts, and external stakeholders.

5. Monitor Exposures
   - Corporate ERM must monitor exposures and ensure they are maintained within risk appetite and risk limits.
   - Corporate ERM is responsible for setting up a general process by which the ERM committee can determine what the exposures are and what the appropriate risk tolerance levels should be, and provide reasonable notice to all relevant stakeholders in advance of violations or an increase in the likelihood of violations, pursuant to a predefined protocol.
6. Inform the Board
   - The CRO has a responsibility to keep the board of directors apprised of key ERM information.
   - Items that are suitable for inclusion in the CRO report to the board include key risk exposures and their position relative to risk appetite and risk limits, future changes in risk exposures, key decisions relating to or impacting ERM, key ERM program activities and enhancements, and any recent significant risk event and ERM lessons learned.

(ii) For each answer in part (i), explain how a corporate ERM function can improve Borah's current decision-making process.

Commentary on Question:
Most candidates provided the sub-points listed above in this section rather than providing a direct application to Borah in their solution. No credit was given if this was done.

1. Build, maintain, and enhance infrastructure:
   - Currently, Borah's scenarios are developed by the VP's in silos.
   - Corporate ERM can facilitate the development of one consistent set of key risk scenarios that can be used by all VP's.
   - Currently there is no evidence of a risk appetite statement for Borah Corp at the enterprise level.
   - Corporate ERM can facilitate the definition of risk appetite and risk limits.
   - Currently, the VPs make decisions based on different criteria: division's value, utility function, and NPV of hedge.

5. Continued

- Corporate ERM can build protocol that defines a common set of metrics and outline the procedures to follow if these metrics exceed the risk limits. Corporate ERM can also develop the protocol for the integration of ERM information into decision making (hedge versus no hedge).
- Currently, the decision that maximizes the East and West Coast divisions' value is to go with no hedge. But VP's utility is maximized with the hedge. There is a disconnect between business performance and incentive compensation.
- Corporate ERM can facilitate the integration of ERM into business performance analysis and incentive compensation.

2. Build Buy In
   - Currently, there is no Corporate ERM and no CRO so each VP makes risk management decision individually based on different criteria.
   - With a CRO, ERM can be integrated into the business and enhance the rigor in all decision making by providing the ability to effectively manage risk and returns together at the Enterprise level.
3. Ensure Consistency
   - Currently, Borah's metrics used include divisions' value, utility function, and NPV.
   - Corporate ERM can provide a single set of metrics that can be used to quantify all types of risks. Corporate ERM can also provide better risk/return characteristics for each risk.
   - Currently the oil price scenarios used by Borah are different between East/West Coast and the Mid West.
   - Corporate ERM can use a consistent risk scenario development technique to standardize a common set of scenarios for all the VP's since commodity prices are uniform across geographic regions.
4. Act as Central Clearing House
   - Currently each VP determines their risk management action independently without aggregating exposures across other geographic regions. (Implies that there is no quantification on offsetting or exacerbation impact of each segment. There is no consideration of diversification effect.)
   - Corporate ERM can aggregate metrics to the enterprise level, and determine the net integrated impact of cross-department risks.
5. Monitor Enterprise Risk Management
   - Currently the VP's have different predictions on how oil prices will turn out, calculate and monitor their impact on division's value (i.e. exposures) individually, and make risk management decisions (hedge versus no hedge) based on their own protocol.

5. Continued

- Corporate ERM team must monitor exposures and ensure they remain within risk appetite and risk limit.
- Corporate ERM can set up a general process to determine what the exposures are, what the appropriate risk tolerance levels should be, and to provide reasonable notice to all relevant stakeholders in advance of violations or in presence of an increase in the likelihood of violations, pursuant to a pre-defined protocol.

6. Inform the Board
   - Currently, only risk management activities are communicated to the COO. Also, more ERM information needs to be communicated to the CRO instead of the COO.
   - The CRO has a responsibility to keep the Board apprised of key ERM information including: individual and enterprise risk exposures, future changes in exposures, key decisions changing exposures, ERM activities, and recent significant risk event

(d)

(i) Describe two of the major ERM roles for the Board of Directors.

Commentary on Question:
Full credit was given if candidates had listed **any two** of the following items in this part and the corresponding part (d)(ii). Majority of the marks were allocated to the main points with partial marks for the sub-points.

1. Awareness of key risk exposures and risk decisions
   - The Board should be aware of the company's major risk exposures.
   - The Board must be up to date on current key risk exposures, particularly in comparison to the risk appetite and risk limits.
   - The Board must be informed in a timely way about significant imminent or emerging threats and corresponding ERM mitigation activities.
   - The Board should be aware of major ERM decisions impacting exposures.
2. Familiarity with ERM Program
   - The Board should understand the ERM framework, including the major elements of each ERM process step.
3. Evaluation of ERM Program Effectiveness
   - The Board has a responsibility to judge the effectiveness of the ERM program.
   - The Board should determine the effectiveness of ERM program design, particularly in managing enterprise risk exposure to within risk appetite.

5. Continued

- The Board should approve policies that link compensation to ERM practices.

4. Involvement with defining risk appetite
   - The Board should provide input in the definition of risk appetite.
   - The level of Board involvement varies, though there has been a trend towards Boards approving the company's risk appetite.
5. Promote Risk Culture
   - The Board should promote a strong risk culture from the top down where employees are aware of the risk appetite of the company.

(ii) Recommend how Borah's Board can fulfill each role identified in part (i).

1. Awareness of key risk exposures and risk decisions
   - Currently the Board only gets informed about risk management activity from each division separately.
   - The scope of the communication with the Board should be expanded to include information needed to understand current risk exposures, particularly in comparison to risk appetite and risk limits, emerging threats, and corresponding ERM mitigation activities.
2. Familiarity with ERM Program
   - The Board hired a consultant to help with building a Corporate ERM function. This is a step in the right direction (you are said consultant).
   - Eventually, the Board should be generally aware of the ERM program design and activities.
3. Evaluation of ERM Program Effectiveness
   - Currently the Board cannot do this because only risk management actions are communicated to the Board.
   - The Board should determine the effectiveness of ERM program design, particularly in managing enterprise risk exposure to within risk appetite.
   - Borah doesn't appear to align compensation with ERM program; Board could suggest and approve this initiative.
4. Involvement with defining risk appetite
   - Currently, there is no evidence of a risk appetite statement at the enterprise level.
   - The Board should provide input in defining risk appetite.
5. Promote Risk Culture
   - There is no evidence that the Board supports a risk culture. More action and ways measure the growth of a risk culture in Borah should be developed.

6. Learning Objectives:

1. The candidate will understand the types of risks faced by an entity and be able to identify and analyze those risks.

2. The candidate will understand measures of corporate value and be able to analyze the data in corporate financial statements.

3. The candidate will understand how the financial risks faced by an entity can be quantified and the use of metrics to measure risk.

4. The candidate will understand the means available for managing various risks and how an entity makes decisions about appropriate techniques.

Learning Outcomes:

(1a) Identify and analyze financial market risks faced by an entity, including but not limited to: currency risk, credit risk, spread risk, liquidity risk, interest rate risk, and equity risk.

(2a) Explain basic account concepts used in producing financial statements:
- In insurance companies
- In other financial institutions
- In non-financial institutions

(2b) Analyze a specific company financial situation by demonstrating advanced knowledge of balance sheet and income statement structures.

(3a) Demonstrate the use of risk metrics to quantify major types of risk exposure in the context of integrated risk management process.
- Demonstrate how each of the financial risks faced by an entity can be amenable to quantitative analysis including an explanation of the advantages and disadvantages of various techniques such as Value at Risk (VaR), stochastic analysis, scenario analysis, and stress testing.
- Describe and evaluate risk aggregation techniques, incorporating the use of correlation, integrated risk distributions and copulas.
- Describe how and why risks are correlated and give examples of risks that are positively correlated and risks that are negatively correlated.
- Assess the overall corporate risk exposure arising from financial and non-financial risks.

(3b) Evaluate the properties of risk measures and explain their limitations.

(3c) Define and evaluate model and parameter risk.

(4b) Demonstrate means for transferring risk to a third party and analyze the costs and benefits of doing so.

6. Continued

(4e) Describe and evaluate risk management techniques that can be used to deal with financial and non-financial risks.

(4f) Develop an appropriate choice of hedging strategy for a given situation (e.g., reinsurance, derivatives, financial contracting), which balances benefits with inherent costs, including exposure to credit risk, basis risk, moral hazard and other risks.

(4k) Define and evaluate credit risk as related to fixed income securities.

(4o) Describe and evaluate risk mitigation techniques and practices: credit derivatives, diversification, concentration limits, and credit support agreements.

Sources:
Tilman, Asset/Liability Management of Financial Institutions

- Ch. 9 Measuring and Marking Counterparty Risk
- Ch. 24 Accounting Standards and Requirements
- Ch. 25 Implications of Regulatory and Accounting Requirements for Asset/Liability Management Decisions

Saunders and Allen, Credit Risk Management In and Out of the Financial Crisis

- Ch.9 the VAR Approach: CreditMetrics and Other Models
- Ch. 12 Credit Derivatives

Hardy, Investment Guarantees, Ch. 9 Risk Measures

FE-C130-07: Hedging with Derivatives in Traditional Insurance Products

CSFB Credit Portfolio Modeling Handbook – Ch. 9, Risk Measures: How Long is a Risky Piece of String?

Commentary on Question:
This question was a highly integrated question testing several syllabus topics, including GAAP asset categorization, credit risk analysis, risk measures, and credit default swaps. Candidates did well on each part of the questions with the exception of part (c). This section was the biggest differentiator between those who did well on this question and those who did not. To receive full credit for this section it was important to draw a conclusion instead of simply providing the mathematical results.
The cognitive levels tested in this question were retrieval, analysis, and comprehension.

Solution:
(a) Describe the implications of selling the Mullan bond if this asset is among several assets categorized as Held to Maturity (HTM) for U.S. GAAP purposes.

6. Continued

Commentary on Question:
This part tested the lower level cognitive skill of retrieval and was answered well by most candidates. They were able to successfully identify implications of selling assets categorized as HTM.

- Sale could taint the remaining HTM portfolio
- Sale of HTM securities could generate large one-time realized gain/loss because the market value gain/loss is deferred
- May restrict the ability to use the HTM classification in the future

(b) Calculate VaR 95 of the Mullan bond value one year from today assuming:

Commentary on Question:
This part tested the higher order cognitive skill of comprehension. Overall, candidates understood the difference between the normal and actual distribution and were able to successfully calculate the mathematical steps of section (b).

(i) The normal distribution

Commentary on Question:
The most common error in section (i) was calculating the VaR(95) as the mean plus 1.645 standard deviation.

LQ E[X] = 2%*100 + 95%*90 +3%*50 = 89
$E[X^2]$ = 2% *100^2 + 95%*90^2 + 3%*50^2 = 7970
Variance = 7970 – 89^2 = 49
Std Dev = 7
VaR(95) = 1.645 * Std Dev = 1.645 * 7 = 11.515

(ii) The actual distribution

Commentary on Question:
Full credit was also given in section (ii) if the candidate solved for the actual VaR(95) using interpolation.

VaR = mean – loan value at 95%ile
Loan value at 95%ile = 90
VaR(95) = 89 – 90 = -1

(c) Using two uncorrelated bonds having characteristics identical to those of the Mullan bond today:

6. Continued

Commentary on Question:
This part of the question was the most challenging for candidates to successfully answer. This part tested the higher order cognitive skills of analysis. Many candidates understood that VaR did not pass the subadditivity criterion and that CTE did, but were not able to adequately demonstrate it. This section of the question used the answers from part (b). If part (b) was answered incorrectly the candidate was not punished for carrying forward the incorrect value into this section.

(i) Demonstrate that VaR is not subadditive, assuming the actual distribution.

Commentary on Question:
When candidates were able to calculate the VaR values needed for the proof, it was important to draw a conclusion based on the results. There were many papers that had the calculations correct but did not draw a conclusion.

Subadditivity: VaR(A+B) <= VaR(A) + VaR(B)

Joint distribution probabilities (only need the following to solve):
Prob{50, 50} = 3%*3% = 0.09%
Prob{50, 90} = Prob{90, 50} = 95%*3% = 2.85%
Since 0.09% + 2.85% + 2.85% = 5.79% > 5%, 95th percentile = 140

E[A + B] = 89 + 89 = 178, from part (b)
VaR(A) = VaR(B) = -1, from part (b)

VaR(A+B) = 178 – 140 = 38
VaR(A+B) = 38 > -2 = VaR(A) + VaR(B), so VaR is not subadditive

(ii) Validate that CTE 95 is subadditive, assuming the actual distribution.

Commentary on Question:
Similar to section (i), it was important to draw a conclusion on whether CTE passed the subadditivity test or not. This section was often omitted from candidates' papers.

Average of worst 5% for single bond is (3%*50 + 2%*90)/5% = 66
CTE(A) = CTE(B) = 89 {from part b} – 66 = 23

Average of worst 5% for combined bonds is (0.09%*100 + 4.91%*140)/5% = 139.28

6. Continued

CTE(A+B) = 178 {from above} – 139.28 = 38.72
CTE(A+B) = 38.72 <= 46 = CTE(A) + CTE(B), so CTE is subadditive

(d) The CRO wants to purchase pure credit default swaps (CDS) to mitigate its credit risk.

(i) Describe how pure CDS work, including all possible cash flows.

Commentary on Question:
This part tested the lower level cognitive skills of retrieval. Most candidates were successful in describing the structure of a CDS. Credit was also given if a diagram was drawn to illustrate the solution in lieu of listing the points as shown in the model solution.

- The protection buyer of CDS pays a fixed fee
- To the protection seller swap counterparty
- If CDS loans do not default the protection buyer receives nothing
- If reference loan defaults, seller will cover default loss by making payment equal to par value of the original loan

(ii) Identify three additional risks the CRO should be aware of prior to purchasing the pure CDS.

Commentary on Question:
Most candidates were able to identify additional risks the CRO should consider. Credit was received for other justifiable answers not listed in the model solution.

- Counterparty risk
- Correlation among market risk factors
- Legal risk of contract enforceability

7. Learning Objectives:

2. The candidate will understand measures of corporate value and be able to analyze the data in corporate financial statements.

3. The candidate will understand how the financial risks faced by an entity can be quantified and the use of metrics to measure risk.

6. The candidate will understand the structure of an ERM process in an entity and be able to demonstrate best practices in enterprise risk management.

Learning Outcomes:

(2b) Analyze a specific company financial situation by demonstrating advanced knowledge of balance sheet and income statement structures.

(3a) Demonstrate the use of risk metrics to quantify major types of risk exposure in the context of integrated risk management process.

- Demonstrate how each of the financial risks faced by an entity can be amenable to quantitative analysis including an explanation of the advantages and disadvantages of various techniques such as Value at Risk (VaR), stochastic analysis, scenario analysis, and stress testing.
- Describe and evaluate risk aggregation techniques, incorporating the use of correlation, integrated risk distributions and copulas.
- Describe how and why risks are correlated and give examples of risks that are positively correlated and risks that are negatively correlated.
- Assess the overall corporate risk exposure arising from financial and non-financial risks.

(6a) Demonstrate the ERM process steps to be followed once the ERM framework is in place:

- Risk identification
  (i) Defining and categorizing risk
  (ii) Qualitative risk assessments
- Risk quantification
  (i) Scenario development/types of scenarios
  (ii) Individual risk quantification, including inherent vs. residual exposures
  (iii)Quantifying enterprise risk exposure, including correlations of risks
- Risk management
  (i) Defining risk appetite
  (ii) Managing enterprise risk exposure towards risk appetite
- Internal reporting
  (i) Performance measurement
  (ii) Performance management and incentive compensation

7. Continued

- External disclosures
  (i) Shareholders
  (ii) Rating agencies
  (iii)Regulators

Sources:
Fridson, Financial Statement Analysis: A Practitioners Guide
- Ch. 1 The Adversarial Nature of Financial Reporting
- Ch. 2 The Balance Sheet
- Ch. 3 The Income Statement

Segal, Corporate Value of Enterprise Risk Management
- Ch. 5 Risk Quantification
- Ch.7 Risk Messaging

FE-C117-07: Doherty, Integrated Risk Management, Ch. 8, Risk Management Strategy: Duality and Globality

Commentary on Question:
This question concerned aligning senior management's incentives with that of shareholders.

Cognitive Levels tested were:
(a) comprehension
(b) retrieval
(c) knowledge utilization

Solution:
(a) Describe two reasons why alternative I may not align the CEO's interests with those of shareholders.

Commentary on Question:
Students should focus on the CEO's intent – an increased bonus. Most students performed well on this part.

Two reasons why a bonus based on stock price growth does not align the CEO's interests with those of the shareholders are 1) information mismatch and 2) poor metrics for calculating the bonus amount.

Information mismatch occurs since management may have inside information which is not available to the market and can be used to management's advantage. Also, management may use information to temporarily (or artificially) drive up the share price.

7. Continued

Poor Metrics: The bonus calculation does not align with enterprise value creation (it would be better to use ERM metrics).

Credit also given for:
The CEO is incented to produce short-term stock price growth and not long term growth. The CEO may be incented to take on extra risks that would increase share price volatility.

(b) Identify three requirements that would promote integrity in the calculation of the baseline company value in alternative II.

Commentary on Question:
Students scored well here. Credit was given for **any three** of the following:

Independence
To have independence, those calculating the baseline company value should not have their compensation affected by the result.
Access to information
The information going into the calculation should be accessible to anyone in the company and the calculations should be straight-forward and well-documented.
Scrutiny
Scrutiny by internal and external auditors would greatly improve the integrity as would review by an independent valuation firm.
Reasonability Check
Compare result to market capitalization. The result should make sense in light of the company's circumstances and market capitalization.

(c) For each compensation plan alternative (I and II), assess whether the CEO is likely to approve or deny the recommendation for each scenario below (A, B, and C) assuming the CEO acts solely to maximize her wealth. Justify each of the six responses.

Commentary on Question:
Two things were necessary here – answer the question with either approve or deny and then support the answer.

IA – the CEO will probably deny the request to strengthen reserves since an increase in reserves will reduce earnings which may in turn lower the stock price.
IB – the CEO will probably approve the request to extend the amortization period since extra amortization time lowers expenses which leads to a gain in earnings and a gain in share price given a constant P/E assumption.
IC – the CEO will probably deny the request for the new investment since it will lead to higher interest expense and reduce earnings in the short term and thus reduce the stock price.

7. Continued

IIA – the CEO will probably approve the request to strengthen reserves since it makes the company more secure and over the long term. The reserve change will only impact the DCF based on the time value of money. The affect on pricing and sales over the long term is less predictable.
IIB – the CEO will probably approve the request to extend the amortization period since extra amortization time lowers expenses which leads to a gain in DCFs and earnings, if the amortization rate is lower than the discount rate.
IIC – the CEO will probably approve the request for the new investment since increased sales on long term product will increase DCF on a discounted basis and will have positive long term effect on the company.

8. Learning Objectives:

1. The candidate will understand the types of risks faced by an entity and be able to identify and analyze those risks.

2. The candidate will understand measures of corporate value and be able to analyze the data in corporate financial statements.

3. The candidate will understand how the financial risks faced by an entity can be quantified and the use of metrics to measure risk.

4. The candidate will understand the means available for managing various risks and how an entity makes decisions about appropriate techniques.

5. The candidate will understand the components of an ERM framework and be able to evaluate the appropriateness of a framework in a given situation.

Learning Outcomes:

(1b) Identify and analyze insurance risks faced by an entity, including but not limited to: mortality risk, morbidity risk, catastrophe risk, product risk, and embedded options.

(2d) Demonstrate how to calculate required capital on an economic capital basis:

- Define the basic elements and explain the uses of economic capital.
- Explain the challenges and limits of economic capital calculations and explain how economic capital may differ from external requirements of rating agencies and regulators.
- Demonstrate the ability to develop an economic capital model for a representative financial firm.

(3a) Demonstrate the use of risk metrics to quantify major types of risk exposure in the context of integrated risk management process.

- Demonstrate how each of the financial risks faced by an entity can be amenable to quantitative analysis including an explanation of the advantages and disadvantages of various techniques such as Value at Risk (VaR), stochastic analysis, scenario analysis, and stress testing.
- Describe and evaluate risk aggregation techniques, incorporating the use of correlation, integrated risk distributions, and copulas.
- Describe how and why risks are correlated and give examples of risks that are positively correlated and risks that are negatively correlated.
- Assess the overall corporate risk exposure arising from financial and non-financial risks.

(3b) Evaluate the properties of risk measures and explain their limitations.

(3c) Define and evaluate model and parameter risk.

8. Continued

(4e) Describe and evaluate risk management techniques that can be used to deal with financial and non-financial risks.

(5e) Compare and contrast various regulatory/industry frameworks: Basle II, Sarbanes-Oxley Act, OSFI Supervisory Framework, OSFI Standard of Sound Financial and Business Practices, UK FSA guidelines, and COSO.

Sources:
FE-C106-07: Mapping of Life Insurance Risks, AAA Report to NAIC

Chapter 10 "Insuring Against Catastrophes" from Diebold et. al.'s The Known, the Unknown and the Unknowable

Economic Capital Modeling – Practical Considerations – Milliman

CRO Forum "A Market Cost of Capital Approach to Market Value Margins"

Hardy, Investment Guarantees, Ch. 9, Risk Measures

Value at Risk: Evolution, Deficiencies and Alternatives, Risk Professional

Measurement and Modeling of Dependencies in Economic Capital

Commentary on Question:
This question tested candidates' understanding of economic capital, how they could calculate economic capital on mortality risk, and some of the model risks that could arise from the given model chosen to calculate economic capital.

Solution:
(a) Identify three recent regulatory developments which might encourage Hamsik to adopt financial reporting and management of its business on an economic basis.

Commentary on Question:
Candidates generally did well on this part. It was a retrieval cognitive level, and most candidates could identify developments that would encourage reporting on an economic basis.

Basel II/III – regulatory standard for international banks
Solvency II, regulatory standard for European insurers
IASB's move to fair value reporting

8. Continued

Additional answers:
Principles-based reserving and capital standards in US
IAIS's development of international solvency standards for insurers

(b) Describe changes to be made to the Hamsik balance sheet in order to restate it on an economic basis. Justify your changes.

Commentary on Question:
This comprehension cognitive level part requested changes specific to Hamsik's balance sheet. Most candidates did poorly on this part. Most candidates missed setting up a reserve for the insurance benefit and struggled with knowing what to hold for required capital.

- Assets and liabilities, currently at book value, should be reported at market value or fair value as appropriate.
- A liability for the insurance component should be added to balance sheet; otherwise liabilities are understated.
- Capital for the insurance benefit should be added at some level of solvency assurance (i.e. capital sufficient to ensure solvency for claims at the 99% CTE level).
- Capital for asset-related risks should be added at some level of solvency assurance (i.e. capital sufficient to ensure solvency for defaults at the 99% VaR level).
- Correlation of risks should be considered so the aggregate level of capital reflects any diversification benefit.

(c) Calculate the required capital for mortality risk using this approach.

Commentary on Question:
The majority of candidates used the binomial distribution to approximate a normal distribution. However, either solution below was accepted. This was a calculation question that many candidates struggled on. It tested candidates' comprehension cognitive level. Few candidates were able to get a large portion of the credit on this question.

Solution 1:
Mean number of claims = Nq = 5000 * 0.0002 = 1
Variance = Nq(1 − q) = 0.9998
Sigma = 0.9999
Pr[X > zp] = 0.975
Pr[(X − Mean)/Sigma > (zp − Mean)/Sigma] = 0.975
Pr(Z > (zp − 1)/0.9999]=0.975
(zp – 1)/0.9999 = 1.96
Zp = 2.96

8. Continued

Capital Requirement = (2.96 − 1)*25,000 = 49,000

Solution 2:
C(nk) * q^k * (1 − q)^N(n − k) k = 0, 1, …, n
P(0) = 0.9998^5000 = 0.36784
P(1) = P(0)/0.9998*1 = 0.36792
P(2) = P(1)/0.9998*0.9998/2 = 0.18396
P(3) = P(2)/0.9998*0.9996/3 = 0.06131

F(0) = P(0) = 0.36784 < 0.975
F(1) = F(0) + P(1) = 0.73576 < 0.975
F(2) = F(1) + P(2) = 0.91972 < 0.975
F(3) = F(2) + P(3) = 0.98103 > 0.975

Thus, claims at 97.5 VaR is 3

Capital Requirement = (3 − 1)*25,000 = 50,000 (which ≈ 49,000 via method 1)

(d) Describe four concerns you have with the method used to calculate the mortality risk capital component in part (c).

Commentary on Question:
To receive full credit on part (d) an explanation was required. The majority of the candidates got partial marks, but very few got a large portion of the marks needed to get full credit. This part tested candidates' comprehension and analysis cognitive levels.

- Binomial and normal models are based on the assumption of independent lives. Hamsik works in a small jurisdiction; sales are concentrated geographically, along with related depositors. Thus, independence may not hold and Hamsik is understating its mortality risk.
- A VaR of 97.5 may not be conservative enough. Hamsik should consider a higher level of confidence.
- Estimation of claims rate is poor:
  - Number of lives is not credible; Hamsik should consider mortality of entire population.
  - Exposure period for each insured is varied (some just qualified, some qualified 2 years ago).
  - Claims rate assumed a constant exposure of 5000. However, new depositors could open accounts and existing depositors could close accounts causing the underlying claims rate to change.

8. Continued

(e) Recommend ways in which Hamsik could better manage its exposure to the mortality risk associated with the insurance benefit it provides.

Commentary on Question:
The majority of the candidates were able to come up with one way to manage the exposure. However, only some of the candidates were able to come up with two or more methods of managing the exposure. This part tested candidates' knowledge utilization cognitive level.

- Hamsik could perform underwriting. Currently, no risk selection is performed.
- Hamsik could protect against anti-selection. The only protection currently available is the 1-year qualification period.
- Hamsik could conduct an experience study.
  - Collect depositor information (age, gender) to better understand mortality profile
  - Measure mortality experience in a more formal way (record exposure amounts, exposure periods, claims, etc.)
- Hamsik could consider reinsurance, like a stop loss arrangement.

(f)

(i) Describe each of the following approaches for calculating aggregate capital.

A. Correlation Matrix Approach
B. Copulas

(ii) List the advantages and disadvantages for each of these approaches.

Commentary on Question:
Part (f) was a retrieval cognitive level question that candidates did well on. Other advantages and disadvantages were accepted that are not listed here.

Correlation Matix: Method relies on variance-covariance matrix to define the relationship between risks.

Advantages:

Easy approach, easy to understand/communicate
Can deal with a large number of risks

8. Continued

Disadvantages:

- Unable to capture tail correlation
- Difficult to parameterize
- May need to rely on expert judgment

Copulas: This method employs statistical methods using marginal distributions to arrive at an aggregate risk distribution. Monte Carlo is often used to simulate the full marginal distribution.

Advantages:

- Can reflect a wide range of dependency structures
- Can reflect correlation at the tail

Disadvantages:

- Complex tool
- Lack of data makes it hard to parameterize
- Requires high computing power

9. Learning Objectives:

1. The candidate will understand the types of risks faced by an entity and be able to identify and analyze those risks.

3. The candidate will understand how the financial risks faced by an entity can be quantified and the use of metrics to measure risk.

Learning Outcomes:

(1a) Identify and analyze financial market risks faced by an entity, including but not limited to: currency risk, credit risk, spread risk, liquidity risk, interest rate risk, and equity risk.

(3b) Evaluate the properties of risk measures and explain their limitations.

Sources:

Saunders and Allen, Credit Risk management In and Out of the Financial Crisis, Ch. 4, Loans as Options: The Moody's KMV Model

Commentary on Question:

Commentary listed beneath question component.

Solution:

(a) Describe how structural credit risk models, like the KMV model, differ conceptually from reduced form credit risk models.

Commentary on Question:

Candidates did fairly well on part (a), a comprehension question. The difference in how defaults are characterized was the key to the response.

Structural models are based on the idea that a firm's asset and equity characteristics are useful in modeling default probabilities. Default occurs when modeled assets drop below modeled liabilities.

Reduced form models do not consider the underlying cause of default like structural models. Rather, they consider the default process to be a force generated outside of and acting upon the firm, using the premise that default probabilities are observable in the spreads being demanded on certain assets.

(b) Compute the one-year theoretical expected default frequency (EDF) for Cavani as of 30 Sep 2008 under the assumption that asset values are normally distributed with standard deviation σ_{CAV}. Show your work.

9. Continued

Commentary on Question:
Many candidates scored well on part (b), a calculation question at the comprehension level. While the factor of 50% for long-term debt for B (suggested in the text) is shown here, any proportion of long-term debt was accepted.

Distance to Default (DD) = (A-B)/(σA), where:
A = assets = 1,604;
B = liabilities = 449 + 728/2; and
σ = asset volatility = 50%

DD = (1,604 – (449+728/2))/(50% * 1,604) = 0.9863
EDF = 1 – Φ(DD) = 1 – Φ(0.9863) = 0.1587

(c) Provide reasons why the EDF computed in part (b) may be overstated and reasons why it may be understated.

Commentary on Question:
Part (c), a deeper-thinking analysis question with the highest number of points, proved difficult for almost all students. Often the key to such questions is to challenge the assumptions used in the calculation. Another clue is to consider why three quarters of financial data were given — while not all data in every question is always used, large amounts of extraneous data is not common.

The EDF may be overstated because:
- σ_A is assumed to equal σ_{CAV}, but the equity volatility may have more to do with overall market conditions than the volatility of Cavani's assets;
- σ_{CAV} is observed at a period of high market volatility, rather than using a more long-term value; and
- Asset growth rates are not incorporated into the calculation.

The EDF may be understated because:
- The use of the normal assumption does not capture the extreme behavior of asset movements; and
- Dividend payments are not incorporated into the calculation.

9. Continued

(d) Describe how the approach taken in part (b) differs from the approach taken by the KMV model to determine an EDF for Cavani.

Commentary on Question:
Many students failed to answer part (d), a more subtle comprehension question, adequately, not recognizing that KMV uses non-normal distributions.

KMV uses an empirical (non-normal) distribution based on actual default data for its default probability, rather than assume a normal distribution. The empirical distribution is based on the ratio of the firms with asset values within a certain number of standard deviations of liability values that actually fail.

10. Learning Objectives:

2. The candidate will understand measures of corporate value and be able to analyze the data in corporate financial statements.

5. The candidate will understand the components of an ERM framework and be able to evaluate the appropriateness of a framework in a given situation.

Learning Outcomes:

(2a) Explain basic account concepts used in producing financial statements:
- In insurance companies
- In other financial institutions
- In non-financial institutions

(2b) Analyze a specific company financial situation by demonstrating advanced knowledge of balance sheet and income statement structures.

(2d) Demonstrate how to calculate required capital on an economic capital basis:
- Define the basic elements and explain the uses of economic capital.
- Explain the challenges and limits of economic capital calculations and explain how economic capital may differ from external requirements of rating agencies and regulators.
- Demonstrate the ability to develop an economic capital model for a representative financial firm.

(5e) Compare and contrast various regulatory/industry frameworks: Basle II, Sarbanes-Oxley Act, OSFI Supervisory Framework, OSFI Standard of Sound Financial and Business Practices, UK FSA guidelines, and COSO.

Sources:

Regulatory Capital Standards for Property and Casualty Insurers under the US, Canadian and Solvency II Formulas

Commentary on Question:

The purpose of the question was to ask the student to:
- Define capital requirements for US and Solvency II regulatory regimes
- Identify Solvency II regulatory capital requirements and calculate the Solvency II balance sheet items
- Compare the impact of changing economic conditions on capital requirements under the regulatory frameworks
- Outline advantages and disadvantages of US and Solvency II regulatory requirements

10. Continued

Cognitive levels tested:
(a) retrieval
(b) comprehension
(c) analysis
(d) retrieval

Solution:

(a) Explain how to calculate the Solvency Capital Requirement of Solvency II using an insurer's economic balance sheet.

- The Solvency Capital Requirement is the 99.5% Value-at-Risk of the change in economic surplus over a one-year horizon.
- Assumed changes in asset and liability risk factors are modeled over one-year horizon and impact on the economic balance sheet is measured.
- Solvency II SCR is the target level of capital below which the regulator will take corrective action to restore the financial health of the insurer.
- May use a prescribed standard model or company's internal model subject to supervisory approval.

(b) Fill in the Solvency II balance sheet for the block at issue by computing:

(i) Best estimate liability

(ii) SCR(PR)

(iii) Cost of capital margin

(iv) Available, required, and free capital

This solution shows the risk free rate expressed as a force of interest, but it was acceptable to treat it as an annual interest rate.

i. Best-Estimate Liability (BEL)
= PV of future liability cash flows at risk-free rate
= ($10,000,000 x 70%) x $e^{-.03}$ = $6,793,119

ii. SCR (PR)
SCR (PR) is a capital charge as the excess of the 99.5% liability over and the Best-Estimate Liability (BEL) at end of year.
99.5% claims and expense liability is 10,150,000 - from table look-up in question text.
10,150,000 – 7,000,000 = $3,150,000.

10. Continued

iii. Cost-of-capital Risk Margin (CCM)
= PV of the cost of meeting future solvency capital requirements to support the run-off of the insurance portfolio.

CCM = i(ccr) x SCR x exp(-r(t) x t), where
- i(ccr) is the fixed cost of capital rate, 6% (given)
- r(t) is the risk-free rate for maturity t

SCR = Basic SCR (given) plus an additional operational risk charge (given).

Basic SCR = (SCR(PR)^2 + SCR(CAT)^2 + 2 x r(PR, CAT) SCR(PR) x SCR(CAT))^0.5…Basic SCR formula and all values are given except SCR(PR). SCR(PR) calculated in part 'ii' above.

Basic SCR = (3,150,000^2 + 1,500,000^2 + 2 x 0.25 x 3,150,000 x 1,500,000)^0.5 = 3,812,480

SCR = Basic SCR + 0.3 x Basic SCR (for Operational Risk Charge)
SCR = 3,812,480 + 0.3 x 3,812,480 = $4,956,224 (used below in 'iv')

CCM = (6% x 4,956,224) x $e^{-.03}$ = $288,585

iv. Available, Required, and Free Capital

Available Capital
= Assets minus Liabilities

Assets: Bonds at market value = $13,000,000 (given)
Liabilities: Non-hedgeable liabilities are BEL + CCM (calculated above)
Liabilities = BEL + CCM = 6,793,119 + 288,585 = $7,081,704

Available Capital
= Assets less Liabilities
= $13,000,000 - $7,081,704
= $5,918,296

Required Capital
= Discount year-end SCR to valuation date
= 4,956,224 x $e^{-.03}$
= $4,809,745

10. Continued

Free Capital
= Available Capital less Required Capital
= $5,918,296 - $4,809,745
= $1,108,551

(c) Assume a market shock on the day following the policy issue day results in the risk-free rate increasing by 2% and credit spreads increasing by 1%. Assume that this market shock does not affect the required return on capital. For each of the following regulatory capital regimes, describe and, where applicable, calculate the effect of the market shock on each line item of the balance sheet:

(i) U.S.

(ii) Solvency II

US Balance Sheet

- Assets are bonds generally held at amortized cost; No change
- Claim Reserve is not discounted for the time value of money
- Unearned Premium "accrual accounting artifact designed to measure incidence of investor profit." Does not depend on interest rates.
- Required Capital is factor-based using annual statement exposures. No change due to interest rate and yield changes.

Therefore, U.S. balance sheet is unchanged.

Solvency II Balance Sheet

Assets

Fair value decreases by 6% due to 3-point increase in yield for option-free bonds with 2-year duration.
Bonds at market value = $12,220,000

Liabilities

= Best-Estimate Liabilities (BEL) + Cost-of-capital Risk Margin (CCM)

Best-Estimate Liability (BEL)

Best-Estimate Liability (BEL) will decrease (2%) since discount rate is 2 points higher for 1-year duration liability.
= PV of future liability cash flows at the new risk-free rate
= ($10,000,000 x 70%) x $e^{-.05}$ = $6,658,606

Cost-of-capital Risk Margin (CCM)

CCM decreases (by about 2%) since end-of-year SCR is unchanged due to interest and is discounted by 2-point higher risk-free rate -- 5% instead of 3%.

10. Continued

SCR (PR)

- Is unchanged since one-year claims and expenses don't vary with interest rate levels

SCR (CAT)

- SCR(CAT) is unchanged since it doesn't depend on interest rates.

Operational Risk Charge

- Operational risk charge is unchanged since it doesn't depend on interest rates.

Therefore, SCR is unchanged. SCR = $4,956,224.

But CCM is discounted at the new risk-free rate
CCM
= 6% x 4,956,224 x exp(-0.05) = $282,870
Liabilities = BEL + CCM = 6,658,606 + 282,870 = $6,941,476

Available Capital
Available Capital decreases. Assets and Liabilities decrease. Assets decrease more since asset duration (2 years) is longer than liability duration (1 year) and the interest/discount rate increases for both.
= Assets less Liabilities
= $12,220,000 – $6,941,476
= $5,278,524

Required Capital
Required Capital decreases since end-of-year SCR is discounted at a higher risk-free rate -- 5% instead of 3%.
= Discount year-end SCR to valuation date
= $4,956,224 x $e^{-.05}$
= $4,714,506

Free Capital
Free Capital decreases. Solvency II liability duration is shorter than asset duration so MV of liabilities decreases less than MV of assets, so less FC.
= Available Capital less Required Capital
= $5,278,524 – $4,714,506
= $564,018

10. Continued

(d) Identify three advantages and three disadvantages of each of the following regulatory capital regimes for Kootenai:

(i) U.S.

(ii) Solvency II

*Credit was given for **three** of the following in each category.*

U.S. Advantages

- Company-specific experience used - equally weighted with industry experience.
- Free capital can increase if Kootenai becomes more diversified.
- Balance sheet stable for volatile interest rates and yields.
- U.S. RBC formula has more LOB classifications: more granular and more risk-sensitive.
- Excessive premium growth risk is reflected.

U.S. Disadvantages

- Opaque, implicit U.S. reserve margins
- Difficult to reliably compare the relative strength of different insurers.
- Free capital not responsive to changes in interest rates and yields.
- Implicit solvency margins on U.S. balance sheets – such as UPR and U.S. reserve non-discounting – are not counted toward regulatory capital in the solvency assessment
- Capital requirement exacerbates underwriting cycles.
- No explicit recognition of operational risk.
- No explicit recognition of interest rate risk
- Kootenai is at 120% CAL, meaning you'll have regulatory issues

Solvency II Advantages

- May use company's internal model.
- Higher free capital even though higher required capital (vs U.S.).
- Transparent capital formulas instead of opaque, implicit margins.
- Free capital is realistically responsive to changes in interest rates and yields.
- Solvency II recognizes and includes charge for interest rate risk.
- SCR formula allows for reduced capital requirements for risk management techniques such as reinsurance and capital market hedging programs.
- Free capital can increase if Kootenai becomes more diversified.
- Market-consistent balance sheet of solvency II is more realistic and relatively objective picture of actual solvency position.

10. Continued

Solvency II Disadvantages

- No allowance for company-specific experience in calculating capital requirement for reserve and premium risk.
- Capital requirement formula exacerbates underwriting cycles. Lower capital required in soft markets and vice versa. Adds pricing risk.

11. Learning Objectives:

1. The candidate will understand the types of risks faced by an entity and be able to identify and analyze those risks.

4. The candidate will understand the means available for managing various risks and how an entity makes decisions about appropriate techniques.

6. The candidate will understand the structure of an ERM process in an entity and be able to demonstrate best practices in enterprise risk management.

Learning Outcomes:

(1d) Identify and analyze strategic risks faced by an entity including, but not limited to:

- Product sustainability risk
- Distribution sustainability risk
- Consumer preferences and demographics
- Geopolitical risk
- Competitor risk
- External relations risk
- Legislative/Regulatory risk
- Reputation risk
- Sovereign risk

(4t) Explain methods for managing this risk, both pre-event and post event.

(6b) Assess how risk and opportunity influence the selection of a firm's vision and strategy and demonstrate how ERM can be appropriately embedded in an entity's strategic planning.

(6h) Describe and assess the elements of a successful risk management function and recommend a structure for an organization's risk management function.

Sources:

Anderson and Schroder, Strategic Risk Management Practice

- Ch. 7 Strategic Risk Analysis
- Ch. 8 Strategic Risk Management – Amendments to the ERM Framework

Commentary on Question:

The goal of this question is to test whether the student can connect where it is necessary to step outside of the structured paradigm of ERM and into the flexible world of strategic risk management. Part (a) tests understanding of what it means to be nimble in strategic planning in a very complex and unknown business environment. Part (b) gets the student to recognize what additional governance is required to manage risk and to adapt to emerging opportunities in a dynamic environment.

11. Continued

Solution:
(a)

(i) Describe how Shoshone's current risk management framework may not be sufficient for the expansion.

Commentary on Question:
Among candidates that answered this part, an analysis question, the responses were reasonably well presented. The key to the answer is that scenario and SWOT analysis deal with known risks but Shoshone faces unknown risk. Many candidates had enough clarity on this point to get most of the credit.

Scenario and SWOT analysis, as practiced by Shoshone, deal with known risks. However, the expansion territory presents unknown risks, which Shoshone's scenario and SWOT analysis do not handle well. Current scenario testing could cause Shoshone to ignore emerging events; the added complexity and uncertainty makes scenarios difficult to forecast for Shoshone.

(ii) Describe elements of acting mindfully, which is a capability of High Reliability Organizations (HROs).

Commentary on Question:
This comprehension question required a description of what "mindfulness" represented with respect to HRO's. Key points of acting mindfully are documented in the course of reading. A few elements of acting mindfully were sufficient to give the candidate full credit on this question. However, this was not well answered, and many candidates did not provide a solution to this section.

Elements of acting mindfully include:

- A well-developed situational awareness
- An ability to see significant meaning in weak signals
- Giving strong responses to weak signals
- Being reluctant to accept simplifications
- Articulating mistakes and organizing how to handle them

(b)

(i) Describe two approaches for creating strategic options.

11. Continued

Commentary on Question:
The reading presents two ways to create strategic options: selection and trial-and-error. There are quite a number of synonymous terms for these approaches and a considerable amount of leeway was given to candidates for a wide range of responses. Full credit for this retrieval question could be obtained by noting the two methods as stated above, with a brief description of each method. However, the majority of candidates did not do well on this section.

When creating strategic options, Shoshone has the option to continue investing or abandon each project/trial/experiment. Deciding to invest or abandon for multiple, independent projects/trials/experiments is applicable to all approaches. The two approaches vary in how the trials are structured.

One approach is systematic experimentation and selection, also known as selectionism or simply selection (**not** trial-and-error). The trials are parallel (taking place at the same time), centrally organized, and planned ahead of time.

Another approach is cyclical experiential learning, also known as trial-and-error, sequential learning, Plan-Do-Check-Act (PDCA), or simply learning. The trials are serial (taking place one after another), not centrally organized, and not fully planned ahead of time, responding to unknown events and new information.

(ii) Recommend which of these approaches Shoshone should adopt. Justify your recommendation.

Commentary on Question:
For candidates that provided a solution to part (b)(i), the solution to part (b)(ii) simply required a selection of the approach that Shoshone should adopt. Candidates that completed the first part successfully generally completed the second part, a deeper analysis question, successfully. Full credit would have been obtained by noting that Shoshone should adopt a selection strategy, with discussion on Shoshone's current risk culture and complexity of the new expansion.

Shoshone should adopt systematic experimentation and selection, as establishing Shoshone quickly in the new territory is critical. Sequential learning/trial-and-error may impose high costs of delay. Also, as selectionism is centrally organized, it is more easily adopted by Shoshone, which has a centrally organized risk management culture.

12. Learning Objectives:

1. The candidate will understand the types of risks faced by an entity and be able to identify and analyze those risks.

4. The candidate will understand the means available for managing various risks and how an entity makes decisions about appropriate techniques.

Learning Outcomes:

(1a) Identify and analyze financial market risks faced by an entity, including but not limited to: currency risk, credit risk, spread risk, liquidity risk, interest rate risk, and equity risk.

(1b) Identify and analyze insurance risks faced by an entity, including but not limited to: mortality risk, morbidity risk, catastrophe risk, product risk, and embedded options.

(4b) Demonstrate means for transferring risk to a third party and analyze the costs and benefits of doing so.

(4d) Evaluate the performance of risk transference activities.

(4e) Describe and evaluate risk management techniques that can be used to deal with financial and non-financial risks.

(4f) Develop an appropriate choice of hedging strategy for a given situation (e.g., reinsurance, derivatives, financial contracting), which balances benefits with inherent costs, including exposure to credit risk, basis risk, moral hazard and other risks.

(4n) Define credit risk as related to derivatives, define credit risk as related to reinsurance ceded, define counter-party risk and demonstrate the use of comprehensive due diligence and aggregate counter-party exposure limits.

(4o) Describe and evaluate risk mitigation techniques and practices: credit derivatives, diversification, concentration limits, and credit support agreements.

(4t) Explain methods for managing this risk, both pre-event and post event.

Sources:

Chapter 10, “Insuring Against Catastrophes” from Diebold et. al.’s The Known, the Unknown and the Unknowable

Doherty, Integrated Risk Management, Ch. 16, Case Study: The Securitization of Catastrophe Risk

12. Continued

Commentary on Question:
This question tested comprehension of various risks that may be introduced when utilizing catastrophic risk management tools.

Solution:
(a)

Commentary on Question:
This part tested the candidates' ability to analyze credit risk in the three provided insurance risk mitigation strategies. It tested the higher cognitive comprehension and analysis skills. Candidates generally did well on describing and ranking the choices, but did not provide much supporting detail.

(i) Describe credit risk for each of I, II and III.

Catastrophic Reinsurance – Use of reinsurance exposes Russet to credit risk because a reinsurer may be unable to pay its obligations.

Catastrophic Options – Use of options may expose Russet to credit risk but the degree depends on the spread of liability amongst the investors who take short positions in these instruments. There is little actual use of options as the liability can change in seconds.

Catastrophic Bonds – Use of bonds does not expose Russet to credit risk because the value of the hedge is independent of the bondholder's assets.

(ii) Rank, from Russet's perspective, the credit risk of I, II and III from lowest to highest. Justify your response.

Catastrophic Bonds < Catastrophic Options < Catastrophic Reinsurance

Catastrophic reinsurance exposes Russet to credit risk because the reinsurer could default. Catastrophic options may expose Russet to credit risk but the level depends on the investors so the risk may be lower than reinsurance credit risk exposure. Catastrophic bonds do not expose Russet to credit risk because the value of the hedge is independent of the bondholder's assets.

12. Continued

(b)

Commentary on Question:
This part tested the candidates' knowledge of the credit risk inherent in reinsurance arrangements, as well as the risk metric issues surrounding mark-to-market involving Catastrophe Options. While subpart (i) tested the higher cognitive knowledge utilization skills, subpart (ii) tested the lower retrieval cognitive skills. Candidates appropriately described two techniques to reduce credit risk but did not provide additional details. Many candidates did not respond to part (ii) of question (b).

(i) Describe two techniques Russet can apply to reduce credit risk when choosing reinsurance.

Russet can spread the risk over multiple reinsurers. Reinsurers operate over a wide geographic region and reinsure a variety of risks so the risk can be sufficiently diversified.

Russet can choose a pool of highly rated reinsurers which are required to have higher levels of capital, reducing the risk of default.

(ii) Describe why mark-to-market may not be an effective tool in mitigating credit risk when choosing Catastrophe Options.

Earthquake losses are incurred in seconds so there is no time available to mark-to-market.

Mark-to-market is good for an underlying asset whose price evolves as a smooth process.

Catastrophes do not have a smooth temporal path because there is little lead time before it occurs.

(c)

Commentary on Question:
Similar to part (a), candidates were asked to assess the basis risk in the three provided insurance risk mitigation strategies. Also as in part (a), both higher cognitive comprehension and analysis skills were tested. Candidates generally did well on describing and ranking the choices, but only provided limited additional details.

12. Continued

(i) Describe the basis risk for each of I, II and III.

Catastrophic Reinsurance – Use of reinsurance exposes Russet to minimal basis risk because payoffs are geared towards actual losses sustained.

Catastrophic Options – Use of options may expose Russet to basis risk. If Russet has a portfolio similar to (different from) the overall index, basis risk will be small (large). Russet's own losses may contribute to the overall index, but the impact will be modest.

Catastrophic Bonds – Use of bonds may expose Russet to basis risk. Earthquakes are significant California catastrophes but may be small on a worldwide scale.

(ii) Rank the basis risk of I, II and III from lowest to highest. Justify your response.

Catastrophic Reinsurance < Catastrophic Bonds <= Catastrophic Options

Reinsurance payments are tied to actual losses so basis risk is minimal. Options and bonds may expose Russet to basis risk but it depends on how similar or different Russet's portfolio is to the underlying index.

(d) Describe one alternative that would reduce basis risk for Russet when choosing Catastrophe Option or Catastrophe Bonds.

Commentary on Question:
This part tests the candidates' ability to reduce basis risk in the provided scenario. It tests the higher cognitive knowledge utilization skills. Most candidates described an appropriate alternative.

Basis risk could be reduced by changing the index to a California earthquake specific index.

(e)

Commentary on Question:
This part tests the candidates' knowledge of moral hazard and asks them to apply it to the provided scenarios. While subpart (i) tests the lower cognitive retrieval skill, subparts (ii) and (iii) test the higher cognitive comprehension and analysis skills. Most candidates appropriately described ex-ante and ex-post. Candidates generally did well on describing and ranking the choices, but limited additional details were provided.

12. Continued

(i) Define ex-ante and ex-post moral hazard.

Ex ante – Russet fails to take action to reduce future claims or takes actions to increase claims because reinsurance is in place.

Ex post – Russet relaxes loss settlement practices because reinsurance is in place.

(ii) Describe moral hazard for each of I, II and III.

Catastrophic Reinsurance – Use of reinsurance does not control moral hazard because Russet may have lax underwriting procedures or pay inadequate attention to the spread of risk. Russet could avoid transaction costs of paying claims and receive goodwill for generous settlements, passing costs onto the reinsurer.

Catastrophic Options – Use of options controls moral hazard. Russet will still receive the benefits from practicing ex ante or ex post mitigation.

Catastrophic Bonds – Use of bonds may or may not control moral hazard. If the catastrophic bond is forgiven dollar for dollar against Russet's own losses, there is little incentive to control losses. If the catastrophic bond is forgiven on an industry index, moral hazard is similar to catastrophic options.

(iii) Rank the moral hazard of I, II and III from lowest to highest. Justify your response.

Catastrophic Options <= Catastrophic Bonds < Catastrophic Reinsurance

Reinsurance does not control moral hazard because Russet can pass losses to the reinsurer. Options control moral hazard because Russet will receive benefits from controlling losses. If the catastrophic bond forgives losses on an index, moral hazard is controlled and similar to cat options.

(f) Describe what Yukon Gold could do to mitigate moral hazard.

Commentary on Question:
This part tests the candidates' ability to mitigate moral hazard in the given scenario. It tests the higher cognitive knowledge utilization skills. Most candidates provided at least one valid method to mitigate moral hazard, but more than one method was needed for full credit.

12. Continued

Yukon Gold can require a deductible so Russet pays all smaller losses as well as a portion of losses exceeding the deductible, incenting Russet to mitigate losses.

Yukon Gold could make future reinsurance terms conditional on previous claims experience which would incent Russet to mitigate losses.

Yukon Gold could increase resources devoted to monitoring behavior of ceding firms like Russet which may be more efficient than ex post rating.

(g) Regarding the Reinsurance option:

Commentary on Question:
This part tests the candidates' ability to analyze the insurance risk of earthquake coverage, as well as their knowledge of exceedance curves. It tests the higher cognitive comprehension skills. Candidates generally did not describe insurability conditions but did note how to construct exceedance curves. Most candidates failed to describe the many uses of exceedance curves.

(i) Describe the two insurability conditions of earthquake risk from Yukon Gold's perspective.

Yukon Gold must be able to identify and quantify the chances of an event occurring.

Yukon Gold must be able to set different premiums for different classes of customers.

(ii) Describe how Yukon Gold can construct exceedance probability curves and use them to analyze its risk on Russet's liabilities.

Commentary on Question:
Students generally described how to construct exceedance curves but failed to describe their use.

Exceedance probability curves are based on output from a catastrophic model that specifies the probabilities that a certain level of total losses will be exceeded. The probability is on the X axis and the losses are on the Y axis. Uncertainty can be incorporated by constructing confidence intervals around the mean curve, creating three curves.

12. Continued

Exceedance probability curves can be used to:

Determine insurability - By building a curve showing the probability that a certain level of loss will be exceeded annually subject to being able to quantify the chances of an event and the ability to set different premiums for customers facing different losses

Determine whether to provide coverage – Russet can satisfy its survival constraint by choosing a portfolio of risks with an overall expected probability of total claims greater than some predetermined amount that is less than some threshold.

Determine premiums – Determine a premium that yields a positive expected profit, avoiding an unacceptable probability and level of loss. Premium must be enough to cover expected claims, other expenses and capital costs.